On the Elderly

Prevention and the Elderly: Risk Factors

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INTRODUCTION

Prevention is an intrinsically attractive concept. Folk wisdom values it at least 16-fold more than cure. Most people would rather never suffer a problem than have to get rid of it. Conversely, however, most are prone to prefer the successful treatment of an identified ailment to the avoidance of "horrible imaginings." Therefore, the relative value a person places on prevention and treatment may well vary according to that person's physical condition.

Older persons, particularly in their seventies and eighties, are likely to suffer from one or more chronic diseases or functional disabilities. The proper place of prevention in reducing or eliminating such problems is hard to evaluate. Discussions about prevention of any condition for any age group tend to get bogged down around related issues of cost and efficacy. Efficacy is often difficult to demonstrate, if only because of the problem of establishing nonoccurrence of rare events. Large-scale, expensive studies are usually required. Then, too, the cost of prevention includes more than the direct costs of preventive programs. A cost-effectiveness analysis must also calculate inconvenience costs, indirect costs (such as evaluating false positives), and untoward consequences of any interventions.

Often preventive steps taken earlier in adulthood are aimed at the diseases and conditions of old age. In such cases, the extraordinarily long time horizon for the chain of events leading to outcomes in old age

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complicates proof of causality. The long past-time horizon poses difficult questions about when during the life course to apply interventions to affect the health of the elderly. Furthermore, if the effective preventive intervention must be applied to youthful or middle-aged target groups, intergenerational transfers in the use of resources may be required. On the other hand, the relatively short future-time horizon (and higher prevalence of chronic disease and disability) makes certain preventive efforts (such as influenza vaccines) easier to demonstrate for the elderly than for other age groups.

The efficacy of applying preventive action to someone *already* old to prevent future disease or disability is influenced by the narrow therapeutic window that characterizes the elderly person. This means that the line between doing good and doing harm with an intervention is hard to distinguish. In the arena of drugs, for example, the range between dosage levels that benefit and those that produce side effects narrows for older patients. Aging does not imply inevitable decline, but it does intensify the risk of iatrogenic consequences of the best-intended actions.

Finally, the traditional taxonomy of prevention is difficult to apply to the elderly. The distinctions between primary, secondary, and tertiary prevention fit poorly into the language of chronic disease. A condition may be simultaneously a preventable disease (and thus a problem in its own right) and a precursor (or risk factor) for another condition that could subsequently ensue. For example, falls, a common geriatric problem, also represent a risk factor for hip fracture. Hypertension is a problem itself and a risk factor for stroke and heart disease. Thus, one can attempt primary prevention of hypertension (through diet modification, for example), whereas control of hypertension (tertiary prevention) becomes primary prevention for stroke.

The World Health Organization has developed a classification pertinent to chronic disease that uses a continuum for impairment to disability to handicap [1]. Intervention may be aimed at preventing the onset of disease (or impairment) or preventing the transition from such an impairment to a disability that results in dysfunction. A disability becomes a handicap in a social context. If, despite compensatory efforts, an individual is disadvantaged for particular tasks or roles, he is handicapped. Thus glaucoma is an impairment, failing vision is a disability, and uncorrectable visual problems may be a handicap for travel or household chores.

Table 1 illustrates the difficulties involved in using this classification in the context of traditional prevention taxonomy. In many instances, the assignment to a specific classification "cell" is arbitrary.

Table 1: Examples of Preventive Activity

Level of Incapacity to be Prevented	*Type of Prevention*		
	Primary	*Secondary*	*Tertiary*
Impairment	Removing hazards in home	Screening for hypertension or cervical cancer	Estrogen therapy for osteoporosis
	Immunization		
Disability	Avoiding bed confinement	Attention to visual and hearing problems in primary care	Stroke rehabilitation
	Decreasing drugs		
Handicap	Specially designed housing for the disabled	Community case-finding—e.g., isolated disabled	Wheelchair ramps

Furthermore, lines blur and overlap; for example, various environmental strategies may constitute primary prevention for some impairments as well as for some handicaps. Similarly, the boundaries between primary and tertiary prevention of handicap break down, as do those between tertiary prevention of disability and tertiary prevention of handicap. Because the distinction between disability and handicap is defined by social role requirements, the preventive strategies for handicaps revolve around changes in the physical and social environment. The important link between health promotion and functional dependency has been emphasized in the Surgeon General's Report [2].

The problem is more than taxonomic. The way we view the chain of events that lead to disability in the elderly determines our view of prevention. The multifactorial chains make the efficacy of any single intervention difficult to determine. Conversely, some behaviors may contribute to several diseases or problems. Their role in any one disease may be minor; yet the summative effect of their contribution may justify advocating the behavioral change.

DEFINITIONS

Several definitional statements are necessary to avoid confusion and tangential discord. The term "risk factor" has been used in the literature to connote a characteristic that identifies an individual as having an increased likelihood of developing a given condition. These factors may be of two types: mutable (personal habits, body weight, and the

like) and immutable (for example, demographic and genetic characteristics such as age, sex, and family history). Unfortunately, it is easy to confuse the latter with the former. For instance, weight may be mutable at any age, yet the effects of obesity on risk of disease may be immutable at some given point. Currently, we lack good information about the risk associated with various behaviors of the elderly and the effect of behavior change in old age on that risk. Epidemiological studies provide evidence of associations but few studies have demonstrated that, even when a characteristic is changeable, reducing that factor leads to reduced risk in the elderly.

Just because a risk factor can be altered does not make it follow that the alteration is effective in preventing the disease or problem of interest. Some risk factors are at best connected to the disease by secondary associations. In other cases, time of exposure may prove an important element in the value of preventive intervention, especially in the elderly. On the one hand, a risk factor may need to have been present for a minimal period before it is associated with increased risk of the disease; for example, obesity does not appear to have a substantial role in heart disease unless it has been present for some time [3]. On the other hand, once a risk factor has existed for a substantial period, it may have produced its effect and thus any subsequent efforts to alter it may be nonproductive; some British geriatricians have taken this position with regard to treating established hypertension [4].

Another set of semantic issues common to discussions about the care of the elderly follows upon the distinction between the so-called "medical" and "social" models. The former is usually pictured as disease focused and is often limited, as a result, to a narrow range of interventions. The social model is generally associated with a focus on positive health and a broader range of therapeutic activities. The effort expended on this separation is not productive. For purposes of prevention, especially in the elderly, the end-stages are disease, disability, and handicap; the etiologies are both physical and social.

Finally, we should define the scope of this discussion. Our task is focused on preventive efforts that can be implemented when the persons of interest are elderly. Certainly, preventive measures taken early in life may mitigate, defer, or prevent the chronic diseases and functional problems of old age, although (for reasons outlined already) the effects of earlier efforts on outcomes in old age are hard to document. More important, we see merit in exclusive attention to exploring the feasibility of efforts directed at the old. Advocating preventive efforts early to maximize their potential effect over the lifespan implies transferring resources away from the elderly to younger people. But the

subject of what can be done during old age to reduce risk of disease and dysfunction or to prolong life is worth separate attention. For people in their sixties and seventies, health is highly salient and the risks to it more immediate. This article summarizes what we know about risk factors for people at that time of life and identifies research needed to develop a sound preventive strategy.

With reluctance born of necessity, we use the conventional age of 65 to define the elderly. Age 75 is a more suitable marker for risk of functional impairment, but unfortunately, many statistical and research efforts fail to present any age refinements among those over 65. When possible, we refer to age categories within the "old."

MORTALITY AND MORBIDITY

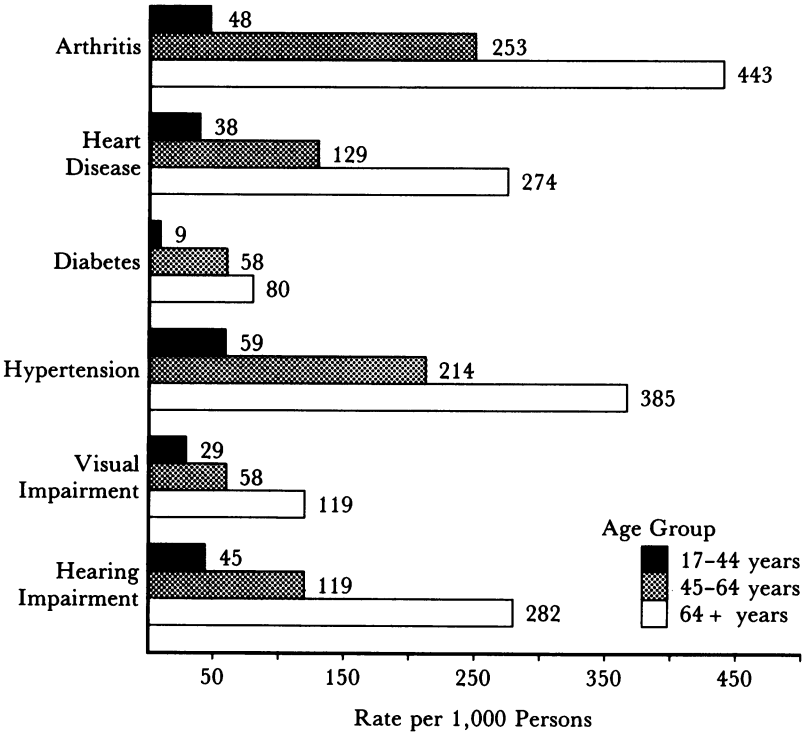
The conditions of concern among the elderly are primarily those associated with chronic disease. Table 2 presents the most recent data available on the leading causes of mortality by age group for persons aged 65 and over. Most of these conditions increase with age, but several peak before age 85, the point at which the various cardiovascular diseases become even more dominant.

Table 2: Death Rates (per 100,000) for Selected Age Groups, U.S., 1978

	Age				
Cause of Death	*65–69*	*70–74*	*75–79*	*80–84*	*85+*
All causes	2,463	3,787	6,024	8,954	14,700
Diseases of heart	1,208	2,030	3,529	5,699	10,288
Malignant neoplasms	698	939	1,216	1,412	1,451
Cerebrovascular diseases	171	341	694	1,239	2,282
Accidents	54	70	108	162	277
Influenza and pneumonia	47	91	189	373	840
Diabetes mellitus	51	82	128	172	212
Arteriosclerosis	15	37	94	220	638
Suicide	18	20	23	22	19
Bronchitis, emphysema, asthma	42	64	88	96	90
Homicide	5	5	5	5	4
Nephritis and nephrosis	12	19	31	44	63
Septicemia	8	13	23	35	55
Cirrhosis of liver	44	38	35	25	18
Peptic ulcer	8	12	20	28	42
Hypertension	6	11	20	35	64
Avitaminoses and other nutritional deficiencies	2	4	10	19	47

Source: [186].

Figure 1: Prevalence of Selected Chronic Conditions



Source: see Reference [187].

The pattern of morbidity is somewhat different. Unfortunately, the same set of age-specific data is not available; data are presented only for those age 65 and older as a group and compared to younger age groups. Figure 1 traces the increase in the prevalence of common chronic conditions with age. A number of nonfatal conditions (not seen in Table 2) are represented here.

The paradigm of the elderly person with multiple chronic conditions argues for a functional approach to describing the problems of the elderly. A list of the common problems of the geriatric population includes a wide variety of items, many of which may have various causes. A representative alliterative array appears below:

- Immobility
- Instability
- Incontinence
- Intellectual impairment
- Infection
- Eyes and ears
- Impotence (sexual dysfunction)
- Isolation (depression)
- Inanition (malnutrition)
- Impecunity
- Iatrogenesis
- Insomnia
- Immune deficiency
- Irritable colon

Prevention of these conditions clearly implies reliance on social as well as medical action.

ORGANIZATION OF THE REVIEW

This review examines selected problems for which preventive strategies have been advocated. For each, we present a model of the steps in the potential preventive intervention sequence and examine the data supporting those steps. We have classified the problems into four general groupings:

1. *Problems that can be addressed in traditional prevention terms.* These are definable diseases or conditions that lend themselves to consideration of the spectrum of primary, secondary, and tertiary prevention. From this group, we have singled out for attention heart disease, stroke, and cancer (major causes of mortality), broken hips (a major cause of morbidity), and infectious diseases such as influenza, pneumonia, and tuberculosis.
2. *Behaviors likely to produce beneficial or adverse effects on health status.* These health behaviors are risk factors rather than diseases or impairments, and evidence about their importance or the mutability of their effects in the elderly is sometimes sketchy or contradictory. Included here are smoking, diet modification, exercise, weight control, social participation, and stress reduction.
3. *Problems requiring attention from caregivers.* Most elderly persons are under fairly regular physician care, providing an opportunity for the discovery of various conditions that cause disability and create handicaps. More active assessment and intervention possibly could prevent dysfunction. (Such caregiver scrutiny is a type of secondary prevention.) Among the problems discernible to those troubling to discern them are visual and hearing impairment, dentition and foot problems, depression, alcohol abuse, and urinary incontinence.

Table 3: A Model for Prevention of Cardiovascular Disease

Underlying Factors	*Underlying Conditions*	*Problem/Disease*	*Functional Result*
Genetics Age Sex Diet: Sodium Saturated fats Carbohydrates Caffeine Obesity Smoking Lack of exercise	Hypertension Hypercholesteremia Impaired glucose tolerance	CHD Stroke	Dysfunction

4. *Iatrogenic problems*. Finally, iatrogenic problems are those impairments, disabilities, and handicaps that result from the caregiving system, including medical care. Paramount among these are adverse drug reactions or drug side effects. Nosocomial infections also fall into this category, as does the functional disability created by overprotective environments or misclassification of patients as needing nursing-home placement.

TRADITIONAL PREVENTION

Traditional prevention allows for all three levels of preventive activity. It also implies a continuum from predisposing factors to underlying conditions to problems (or disease states) to resultant dysfunction. Perhaps the best example of this continuum is found in the cardiovascular diseases, especially heart disease and stroke. Table 3 illustrates risk factors for cardiovascular disease along such a continuum, and Table 4 does the same exercise for fractures.

Conventional gerontologic wisdom argues that the potential for primary prevention of chronic disease incidence declines markedly with age. Until recently, demographic data supported that position. The probability of death increased geometrically with advancing age and seemed to change little from one generation to the next. Any gains achieved in one area seemed immediately compensated for by loss in another. A decrease in heart disease thus would be compensated for by an increase in death from other causes.

The theory of competing risk [5], based largely on these observations, suggests that those who survive into old age represent either a resilient group or the beneficiaries of modern medical care. Persons with poor health practices or high vulnerability will have succumbed,

Table 4: A Model for the Prevention of Fractures in the Elderly

Underlying Factors	*Underlying Conditions*	*Problem/ Disease*	*Functional Result*
Inadequate foot care Impaired vision Medication effects/Alcoholism Gait impairments Environmental hazards Improper clothing and shoes	Falls	Fracture	Immobilization
Genetics Age Sex Lack of exercise Diet: Decreased calcium	Osteoporosis		

probably, before old age. Thus, whatever has worked to facilitate survival to this point—a combination of exposure to risk and resilience—should not be tampered with. Some geriatricians accept the nihilistic corollary that precursor conditions act slowly but permanently to induce changes of disease; once these changes occur, they see little point in attacking the precursor.

This view of clinical prevention and aging has been challenged by recent events. The mortality rate in the very old is decreasing—that is, extending to even more advanced age—especially for heart disease and stroke. Competing claims by those who give credit to more effective treatment and by those who point to recent changes in life-style and prevention practice—especially in greater awareness of hypertension—are difficult to substantiate. The available data include some encouraging results from longitudinal studies and controlled trials to support enthusiasm for prevention with younger adults [6], but the definitive answers are not readily forthcoming [7].

HEART DISEASE

Prevention of cardiovascular disease corresponds to the disease modes of prevention in the elderly. Underlying host factors have been well documented in several long-term studies, such as the Framingham study [8], and include both genetic and behavioral factors. Underlying conditions such as hypertension, hypercholesterolemia, and impaired

glucose tolerance are well-known risk factors for cardiovascular disease. Interventions taken after the onset of the disease, including drug therapy, behavioral changes, and rehabilitation, may prevent or minimize the dysfunction caused by cardiovascular disease.

The risk of cardiovascular disease has been correlated with age, sex, and genetic history. Cardiovascular disease affects 50 percent of those over 70, but only 11 percent of those under 40 years [9]. The risk difference between the sexes, readily apparent at younger ages, disappears in the elderly [10]. Genetic factors also play a role in risk of cardiovascular disease, demonstrated by the higher incidence in certain families or ethnic groups. While these inherent factors may prove valuable in identifying high-risk groups for other interventions, they play a minimal role in the strategy of prevention.

Smoking

The behavioral factors amenable to prevention are generally the focus of early preventive efforts aimed at creating "good health habits" for a lifetime. Cigarette smoking plays a significant role in mortality from cardiovascular disease [11]. Cigarette smoking is a significant factor in morbidity, exacerbating hypertension, another risk factor for cardiovascular disease [12]. Although few specific data are available on the effects of smoking on the elderly and the benefits to them from stopping, in view of the negative effects of cigarette smoking, the recommendations for smoking cessation among the elderly appear eminently justified.

Exercise

Physical inactivity is associated with a number of physiological changes that may cause or exacerbate cardiovascular disease. Enforced physical inactivity, as demonstrated by astronauts and persons confined to bed, results in increased systolic blood pressure, increased total peripheral resistance, increased serum levels of cholesterol, and glucose intolerance [13, 14]. The definitive link between physical exercise and reduction in risk of cardiovascular disease has not yet been found, although the Paffenbarger study [15] of Harvard alumni did find a modest association. Again, as with smoking, the generally positive effects of physical exercise on the body support the use of exercise in a prevention strategy.

Diet

Poor dietary habits have also been implicated as a causal factor in cardiovascular disease [3]. Obesity has been associated with an increased risk of hypertension and hypercholesterolemia, as well as glucose intolerance; however, it is unclear whether current obesity or a history of obesity is the risk factor. If only a long-standing history of obesity correlates positively with cardiovascular disease, then it is questionable whether weight should be considered a modifiable risk factor in the elderly.

Diets low in saturated fat and high in vegetables and fiber have also been recommended for the prevention of cardiovascular disease. The North Karelia study [16] demonstrated that a diet high in vegetables and low in saturated fats can reduce blood pressure in normotensive subjects. The reduction of blood pressure an average of 9 mm Hg systolic and 7 mm Hg diastolic occurred slowly and did not level off during the 6-week study period. Rouse et al. [17] were successful in reducing blood pressure in normotensive subjects placed on a vegetarian diet. Sodium in the diet has been linked with hypertension, and a 25 percent reduction in salt intake may be associated with a 5–10 mm Hg reduction in blood pressure [12].

While these dietary changes may reduce the average blood pressure of the subjects, it remains unclear whether they actually reduce the incidence of cardiovascular disease. Long-term compliance with exercise and dietary regimens, while clearly desirable, has not proved satisfactory in the past. In addition, it is questionable if late-life behavioral change will erase a lifetime of damage.

Stress

High levels of stress have also been associated with hypertension and cardiovascular disease. The Type-A personality, characterized by impatient, time-conscious behavior and high levels of stress, appears to correlate with an increased risk of cardiovascular disease. However, more recent evidence cautions against modification of that aspect of behavior in the elderly [18]. Although aggressive, competitive behavior may have a negative effect on morbidity in younger persons, the reverse is sometimes seen in the elderly. Whether this is a case of Darwinian survival of the fittest or the adoption of new, adaptive behavior patterns remains to be seen. In any event, persons characterized by nursing-home staff as belligerent and/or cantankerous have shown better ability to achieve functional rehabilitation goals than their more passive and better-liked counterparts [19]. This phenome-

non, which might be dubbed the "curmudgeon factor," has been found serendipitously; it has not been studied systematically with respect to specific diagnoses nor has it been balanced against Type-A and Type-B personality information. But informal evidence appears to bear it out.

Hypertension

Another stage in prevention involves the identification and treatment of the underlying conditions that predispose the elderly person to cardiovascular disease. Hypertension in the elderly is defined as blood pressure greater than 140/90 mm Hg, or systolic blood pressure greater than 160 with normal diastolic blood pressure. If one accepts extrapolated evidence from intervention trials—the old-old (that is, people age 75 and over) have been excluded from or under-represented in most of these—control of moderate and high diastolic hypertension is associated with reduced mortality and morbidity [10]. High blood pressure (hypertension) is the most powerful predictor of risk for cardiovascular disease: more than half the persons with myocardial infarction and three-fourths of patients with stroke have concurrent hypertension [10]. There is a strong association between increasing blood pressure and advancing age: 33 percent of persons in their sixties have elevated pressure compared with 11 percent of persons in their thirties [12]. Many clinicians attribute the increase of blood pressure with age to the body's natural response to counteract the obstructive nature of atherosclerosis [20]. However, even mild increases in blood pressure over 140/90 mm Hg have been associated with substantially increased risk of death due to cardiovascular disease [21], and thus this elevation should properly be considered hypertension.

Because hypertension is asymptomatic and yet is clearly associated with reductions in risk accompanying decreases in blood pressure, substantial resources have gone into community screening programs. These screening programs generally have been successful in detecting persons with hypertension, and the proportion of persons who are aware of their blood pressure has been increasing steadily in the past two decades. In fact, recent studies show that the elderly are more likely to know their blood pressure than are younger persons [22]. One substantial problem with past hypertension screening efforts is that, while they may detect many cases of hypertension, they do not usually offer a satisfactory treatment program—and in fact may be repeatedly detecting the same cases of hypertension. According to 1973 data from the Minnesota Heart Survey [23], 20 percent of the identified hypertensive persons had known but untreated hypertension, and 25 percent

had previously undetected hypertension. In 1980, the same study revealed that only 9 percent of hypertensives were untreated, and 68 percent of previously undetected hypertensives were identified. Although large community screening programs may have been instrumental in the detection and control of hypertension, the low proportion of untreated and previously undetected hypertensive patients identified in more recent programs does not appear to justify the high costs involved in continuing programs. The emphasis now needs to be put on treatment rather than detection.

Non-drug treatment of hypertension usually involves modifying behaviors such as poor dietary habits and a sedentary life-style. More specifically, reductions in salt and saturated fat intake and a program of increased exercise may be indicated. Although behavioral factors have proved to be important in causing or exacerbating hypertension, the elderly may be uninformed about the risks. Of persons age 65 and older, only 18 percent believe that being overweight causes hypertension, and 11 percent believe excess salt, 6 percent believe smoking, and 3 percent believe lack of exercise causes hypertension [24]. These knowledge deficits, in turn, may be blamed partly on professionals. It is often stated that poor compliance with behavioral change has made drug treatment for hypertension necessary. But the survey just cited also determined that 61 percent of the elderly had never been told to go on a weight-loss diet, and only 66 percent had been told to eat less salt to control their blood pressure. Traditional care has consisted of antihypertensive agents; recently, a stepped-care regimen has often been recommended. The stepped-care regimen begins with a diuretic, then adds additional drugs as required: adrenergic blockers, vasodilators, and guanethidine sulfate [25].

Isolated systolic hypertension has been correlated with an increased risk of stroke [20, 26], but there are conflicting data concerning the efficacy of treatment for isolated systolic hypertension [25, 12]. The data on the benefits of treating mild hypertension are even less clear. The Joint National Committee on Detection, Evaluation, and Treatment of High Blood Pressure [25] cites the findings of the Hypertension Detection and Follow-up program to argue the benefits of treating any level of hypertension in the elderly. Elevations in diastolic blood pressure are related to an increased risk of cardiovascular death and myocardial infarction [20]; however, overall mortality does not appear substantially different between treated and untreated persons with mild hypertension [27].

The adverse side effects of antihypertensive medications have been well documented and include impotence, gout, impaired glucose

tolerance, and postural hypotension [28]. Although the benefits of drug treatment for high-risk patients outweigh the dangers, the data are not so clear for the borderline hypertensives. In view of the especially high risk of drug reaction in the elderly and the questionable value of treatment, an individual approach is recommended.

Diabetes

Impaired glucose tolerance has been implicated as a risk factor for cardiovascular disease because of the high incidence of vascular complications in persons with diabetes mellitus. Obesity has been strongly correlated with impaired glucose tolerance; 80 percent of adult-onset diabetics are obese or have a history of obesity; 60 percent of persons with 125 percent or more of ideal body weight have impaired glucose tolerance tests [29]. Treatment of adult-onset diabetes usually involves weight reduction and dietary modifications, including a decrease in sugar and carbohydrate intake. Drug treatment, in the form of hypoglycemics or insulin, may be indicated. While these interventions decrease glucose levels in diabetics, data on their efficacy in the prevention of cardiovascular disease remain unclear [30]. However, the trends suggest a favorable prognosis with long-term management of diabetes.

Cholesterol

The association between serum cholesterol levels and cardiovascular disease appears to be a function of the atherosclerotic lesions that may develop on the arterial walls. The National Heart, Lung, and Blood Institute Type II Coronary Intervention study has provided evidence that, for persons with Type II hyperlipidemia, or extremely elevated levels of cholesterol, treatment with the drug cholestyramine in addition to a diet low in fat and cholesterol will lower serum cholesterol levels [31]. The same study provides suggestive evidence that reductions in serum levels may correspond to reductions in the incidence of coronary artery disease [32, 33]. However, this study excluded the elderly, and other studies on persons with mildly elevated levels of serum cholesterol have not provided similarly positive results [34]. In addition, the Framingham study found that the association between serum cholesterol levels and cardiovascular disease decreases with age, having little impact on the elderly [8].

Rehabilitation

There is active interest in rehabilitation (usually in the form of exercise regimens but including drugs, stress reduction, and other techniques) after the episode of coronary heart disease has been resolved. The elderly have frequently been excluded from such efforts or have not been examined as a specific subgroup. Several classes of drugs may be used to prevent a recurrence of coronary heart disease. Medical treatment with antiarrhythmics has not proved successful in clinical trials. Although the results are not statistically significant, the outcome for the control groups, in terms of mortality, appeared better than for the treated groups. The *beta* blocker and platelet-active drugs appeared to exert an overall positive effect in several trials [35]. A small daily dose of aspirin has proved beneficial in the prevention of recurrent myocardial infarction [36, 37]. Although the overall picture is mixed, exercise appeared to exert a positive effect by reducing mortality in several trials [35]. Coronary bypass surgery has proved successful in patients with more than one coronary artery affected [38].

The benefit of intensive rehabilitation after the manifestation of coronary heart disease is not as well substantiated as is rehabilitation after stroke. The goals of cardiac rehabilitation include improved quality of life, enhanced risk-factors modification, and improved ability to perform such activities as recreational exercise, work, or sex [39]. A controlled study of the effect of an intensive exercise program showed improved ability. However, the improvement was apparent only in formal testing; it did not appear to reflect a significant difference in actual activity [40]. More evidence is needed before physical rehabilitation after coronary heart disease can be recommended for widespread use.

STROKE

The risk factors for stroke are much the same as those for heart disease: hypertension, hyperlipidemia, and diabetes mellitus. In addition, rehabilitation to arrest or minimize the dysfunction addresses the paralysis often accompanying stroke.

The behavioral risk factors for stroke include cigarette smoking, lack of exercise, and poor dietary habits. The data concerning the efficacy of smoking cessation in the prevention of mortality from stroke are unclear [4]. In his study on risk factors in Harvard alumni, Paffenbarger [15] identified increased body weight, nonparticipation in athletics, and hypertension as important risk factors for stroke; present

nonparticipation in athletic events was a much stronger risk factor than previous nonparticipation.

Dietary modification to reduce the intake of salt and saturated fats is also considered an important component of the treatment, as is a diet to reduce weight in obese persons. The benefit of reducing serum cholesterol levels is less clear [34]. Diabetes mellitus appears to be a risk factor for stroke, but data remain inconclusive regarding a reduction in risk with treatment. Recent evidence suggests that a history of controlled diabetes provides a greater reduction in risk than present control [41].

The Framingham study [8] determined that elevated blood pressure, specifically systolic hypertension, is a good indication of the risk for stroke in the elderly as well as the younger population. In contrast to previous geriatric theory, this risk persists in those with vascular rigidity. The NARG study [4] found a stroke more strongly related to a history of diagnosed hypertension than to present blood pressure.

While motivation may be high to change risk factors after the manifestation of disease, the possibility of irreversible damage cannot be excluded. Treatment for the "mechanisms" of disease rather than the "causes" may be more appropriate [4]. Anticoagulants, aspirin, and vasodilator drugs have proved beneficial in preventing subsequent strokes [42].

The mean survival time after the occurrence of stroke is 7 years, and a full 30 percent of patients survive 11 or more years after acute stroke [43]. Data from the Framingham study indicate that, following stroke, 33 percent of patients remain dependent in activities of daily living (ADL), 20 percent require human assistance with ambulation, and 15 percent require institutionalization [44]. Given the high incidence of stroke in the elderly, functional disability following stroke is a significant problem.

Rehabilitation has become an accepted part of medical treatment following stroke. Because a randomized trial to determine the benefits of rehabilitation against no rehabilitation would surely be ruled out on ethical grounds, new studies must be confined to assessing the relative benefit of different intensities of rehabilitation given in different settings on different levels of impairment. It is generally accepted that intensive rehabilitation after stroke is not indicated for all patients [45]. Patients who are unconscious during acute stroke are likely to remain dependent, and patients who remain conscious and are able to walk unaided generally exhibit spontaneous functional recovery [46]. Consequently, the results of clinical studies that do not differentiate between the level of initial impairment may be biased.

A recent, well-designed study [46] showed that intensive rehabilitation in a specialized stroke unit resulted in greater functional recovery (52 percent versus 32 percent of patients exhibited functional independence) in a shorter period of time (average stay of 55 versus 75 days) than for patients given traditional rehabilitation on the medical wards. The investigators selected patients who remained conscious during acute stroke but who exhibited developing or established hemiplegia as representative of patients likely to survive but unlikely to experience spontaneous recovery; therefore, they could validly make comparisons between the two intensities of treatment. A separate study [47] found that age (under 80), sex, and the presence of concurrent medical conditions did not affect functional outcome after rehabilitation, suggesting that the degree of impairment from stroke is a valid criterion for patient grouping.

Rehabilitation programs generally provide physical and occupational therapy to improve function in ambulation and self-care; however, they have been criticized for not attending to aspects of functioning that enable the person to maintain an independent life in the community. DeJong and Branch [48] observed a high correlation between the ability to function independently in the community and the ability to get into an automobile, an area they thought should receive more attention. Perhaps the *handicap* inherent in the inability to enter an automobile should be the focus of social engineering to determine substitute forms of "independent" transport.

By judging the effectiveness of rehabilitation in terms of functional improvement, one necessarily neglects other benefits from rehabilitation, including psychosocial and quality-of-life improvements, which cannot be measured by ADL scales [47]. For example, rehabilitation may include optimism and an enhancement of the patient's sense of control. Future research efforts should strive to determine the range of other benefits, if any, derived from intensive rehabilitation, and whether these benefits can be provided most cost effectively in specific settings. For example, the psychosocial benefits of exercise, diet, stress reduction, education, and socialization may be equal in programs under recreational and educational auspices, and the costs may be much lower than in programs offered under medical auspices.

CANCER

Cancer is the second leading cause of death among the elderly, directly causing 19 percent of the deaths in persons over age 65 in 1978 [49]. Although at present no known method of preventing cancer exists,

early detection may allow treatment and subsequent eradication of the disease, or may at least prolong the time before death. The risk of cancer increases with age. At age 40, the risk of developing a primary site cancer is less than 0.2 percent; at age 60 it is 1 percent; and at age 80 it is 2 percent [50]. Some cancers (for example, breast, cervix, and uterus) exhibit a highly significant relationship between advancing age and advancing stage at diagnosis [51]. It is not clear whether this is the result of inadequate care or a difference in disease course. In an exploratory study, Rimer et al. [52] found that the elderly held false beliefs about cancer (including the lack of appreciation of increased risks with age) together with a number of negative attitudes about medical practitioners that might prevent their seeking timely care for cancer symptoms. This, combined with failure of routine surveillance in the course of medical care, might account for later stage at diagnosis.

Cancer screening programs for aged women may prove to be especially cost effective. Table 5 shows the leading causes of cancer deaths for men and women in the middle and aging years. For men, the lung, colorectal area, and prostate are the most prevalent sites. For women, the three major sites are breast, lung, and colon-rectum, with the last becoming more important among the elderly.

The incidence of cancer over time is shown in Figure 2. Cancer death rates for elderly males continued to increase, but the rates for elderly females are a more recent phenomenon. The rising rate of female deaths from lung cancer is alarming, and this change seems directly related to increased smoking in later generations.

Breast

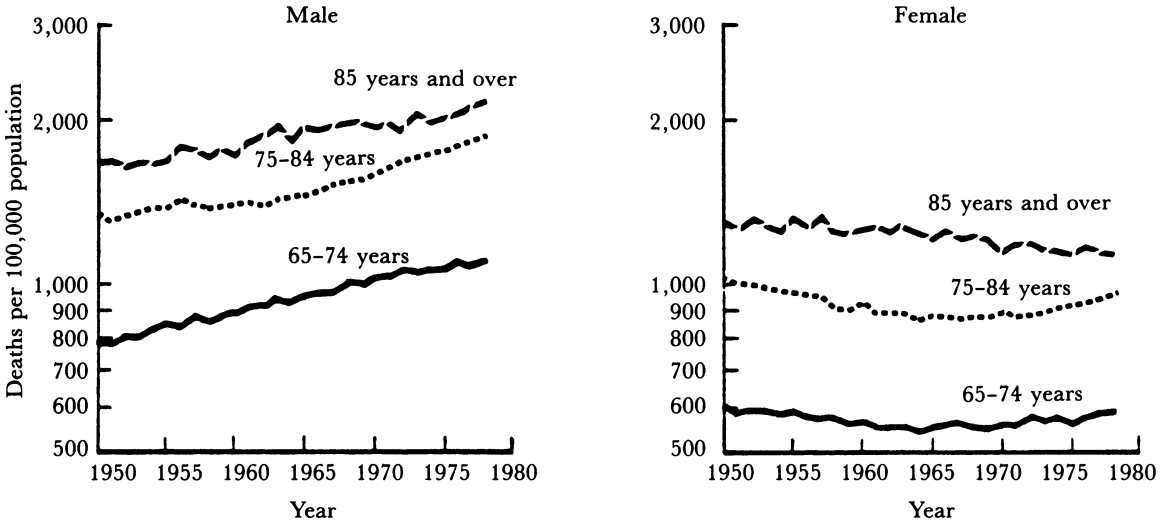
Because 80–90 percent of primary breast cancers are detected by women themselves [53], breast self-examination (BSE) has been promoted as an effective, inexpensive way to increase the chance of early detection of breast cancer. One study of BSE practice and breast cancer stage [54] determined that 75 percent of women age 70–98 who practiced BSE monthly presented with TNM stage I cancer, and none presented with advanced breast cancer (that is, stage III or IV). Of the women who never practiced BSE, only 14 percent presented with cancer in stage I, and 45 percent presented with advanced cancer. Many researchers have hypothesized that women who practice BSE are more highly educated, take more responsibility for their health, practice other health-promoting activities, and thus would be more likely to detect tumors even if they did not practice BSE. Moore points out the difficulty in distinguishing between women who find their breast can-

Table 5: Mortality for Five Leading Cancer Sites for Selected Aged, 1978

All Ages		*35–54*		*55–74*		*75 +*	
Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Lung (71,006)*	Breast (34,329)	Lung (10,214)	Breast (8,205)	Lung (46,049)	Breast (17,403)	Lung (14,446)	Colorectal (12,626)
Colorectal (25,696)	Colorectal (27,080)	Colorectal (2,462)	Lung (4,679)	Colorectal (13,717)	Lung (14,463)	Prostate (12,298)	Breast (8,129)
Prostate (21,674)	Lung (24,080)	Pancreas (1,262)	Colorectal (2,210)	Prostate (9,047)	Colorectal (12,551)	Colorectal (9,325)	Lung (4,819)
Pancreas (11,010)	Uterus (10,842)	Brain/CNS (1,282)	Uterus (2,111)	Pancreas (6,490)	Ovary (5,992)	Pancreas (3,208)	Pancreas (3,939)
Stomach (8,529)	Ovary (10,651)	Leukemia (1,065)	Ovary (2,029)	Stomach (4,558)	Uterus (5,480)	Stomach (4,558)	Uterus (2,954)

Source: [68].
*Deaths.

Figure 2: Death Rates for Malignant Neoplasms Among Persons 65 Years of Age and Over, According to Sex and Age: U.S., 1950-78



Sources: National Center for Health Statistics: *Vital Statistics of the United States*, Vol. II, 1950-76. Public Health Service. Washington, U.S. Government Printing Office, and 1977-78 to be published, and unpublished data. See Reference [49].

Notes: Death rates for the group 85 years of age and over in 1970 are based on population estimates revised by the U.S. Bureau of the Census to correct for overestimates of the group 100 years of age and over. See footnote 3 in text for more complete discussion. ICDA codes are as follows: for 1950-67, 140-205 and for 1968-78, 140-209.

cers by BSE or by a heightened awareness of their bodies [55]. Bennet and his colleagues [53] found no difference in health-promoting activities between women who practiced BSE and those who did not, but they noted a significant difference in the level of education. In addition, the Bennet group found a significant relationship between the fear of losing a breast to cancer and not practicing BSE.

Another study, looking more critically at the benefits of BSE, found that only 51 percent of women practicing BSE did so on a monthly basis and that many women were not practicing BSE correctly, as evidenced by the relatively large number of advanced cancers detected in this group [56]. This study also determined that only 69 percent of women practicing BSE actually discovered their tumor in this manner. While a significant number of tumors are detected by a routine physical examination both in women who do and who did not practice BSE, it appears that accidental findings are fewer in women who practice BSE.

Although the efficacy of BSE may be questioned, there is no doubt that earlier detection of breast cancer improves prognosis (with the usual disclaimer that improved survival time may be an artifact of early detection) [57]. The 5-year survival rates for elderly women treated by radical mastectomy (the "traditional" form of treatment) with localized disease is 85 percent; for regional disease, only 59 percent [58].

BSE programs have been concentrated on easy-to-reach populations—schoolgirls, working women, hospital employees. The relatively high-risk woman over 65 is less often reached and may find conventional BSE instruction/practice techniques less acceptable. In ten demonstration projects with goals that included early detection of breast cancer, only one developed audiovisual and other techniques *specifically* designed to reach older women [59]. That project won high acceptability for its approaches in rural Vermont communities. Methods included use of church groups and women's clubs, special films with older women in realistic situations, use of private rooms for examination, and instruction in conjunction with small meetings held in persons' homes [54].

Routine physical examination, thermography, and mammography are the other methods of screening used to detect breast cancer at early stages. The American Cancer Society [60] recommends examination by a physician and annual mammography for breast tumors every year for women over 40 years of age. Mooney [61] recommends mammography and physician examination as the most cost-effective method of detecting early breast cancer. He concluded that thermogra-

phy gives a higher proportion of false negatives and thus costs more per cancer detected. A screening program of mammography and physician clinical examination instituted for 7 years detected a 40 percent decrease in mortality between screened and nonscreened women [62]. In view of the dramatic improvements in the quality of the mammography equipment, the risks of inducing cancer are minimal and far less than the risks of not detecting breast cancer until later stages.

Cervix

The Papanicolaou cytologic (pap) smear is a screening test to detect cancer of the cervix. An association has been found between the implementation of screening programs and a decline in mortality rate from this cancer [63]. Some sources have suggested that the decrease in mortality is due to a decrease in the incidence of cervical cancer, which began just prior to the widespread screening programs [64]. The American Cancer Society recently revised its recommendations from an annual pap smear to one every 3 years [65], because of the decreased risk of an abnormal smear after three negative smears (the difference between incidence and prevalence). Proportionally fewer elderly women have ever had a pap smear—59 percent of the population over age 65 compared to 90 percent of women age 25–44 [66]. This is probably because widespread use of the examination did not occur until the 1950s, and most of these women were past their childbearing years (when they would most likely see a gynecologist). According to data from a number of health surveys, many women who were likely to have regular pap smears discontinued that practice after menopause [67]. This is especially significant, because a high proportion of cervical cancers found in older women are diagnosed after local or regional spread. The pap smear should be especially encouraged in elderly women as part of a regular preventive health care regimen.

Colorectal

Colorectal cancer has the highest incidence of cancer mortality in persons over age 75, accounting for more than 20,000 deaths in 1978 [68]. The 10-year survival for persons with localized cancer is 67 percent, compared to 36 percent for nonlocalized cancer. Because only 41 percent of all colorectal cancers are detected at a localized stage [69], the early detection of colorectal cancer should be a high priority in the prevention of disability and death from cancer.

The guaiac test for fecal occult blood is a simple, inexpensive method for detecting asymptomatic colorectal cancer, the majority of

which are in a localized stage [70]. Because the test detects only fecal blood, it is not specific for colorectal cancer and could signify a number of other medical conditions. Studies have shown that the rate of a positive test increases with age [71]. However, a study by Hardcastle and his colleagues [70] demonstrated that fewer persons over age 70 accepted an invitation to take the screening test than did younger persons (27 percent versus 38 percent). The low rates for both of these age groups signify a need to develop ways to increase the acceptance for the screening examination. It has been suggested that an educational letter or interview may increase acceptance as much as 50 percent [70]. There are no good data to determine the optimal frequency of the test at this time; however, the use of the test in conjunction with a regular physical examination seems justified.

An annual sigmoidoscopy examination to detect colon cancer is recommended by the American Cancer Society [65]. However, many clinicians have objected to the mass use of this screening method, given its unpleasantness and high cost [64]. The International Workshop on Colorectal Cancer has recommended sigmoidoscopy every 3 to 5 years for the elderly. Most colorectal cancers arise from preexisting adenomas [72], and it may take 5–10 years for an adenoma to develop into a carcinoma [69]. Because of the relatively slow growth in colorectal cancers and the possible damage that may be incurred by the sigmoidoscopy procedure (i.e., rupture of the colon), the examination should not be done more often than every 3–5 years.

FRACTURES

Fractures in the elderly cause enormous disability. This problem adapts well to the disease model of prevention (see Table 4). Risk factors include genetic, behavioral, environmental, and medical elements. The propensity to fall and the presence of osteoporosis, alone or in combination, appear to be the primary causes of fractures in the elderly. Some suggest that, especially in the presence of osteoporosis, hip fracture may cause the fall, rather than the reverse [73].

Women between 50 and 75 years of age have an estimated 1.3 percent chance of radial fracture and a 0.7 percent chance of hip fracture [74]. The incidence of fracture rises dramatically with age: for women between 75 and 79, the incidence of hip fracture is 6 per 1,000 women; for women between ages 85 and 89, the incidence increases to 21.4 per 1,000; and for women over 90, the incidence is 48.6 per 1,000 [75]. Women with osteoporosis are more likely to develop trochanteric fractures, which are associated with less trauma [73]. The estimate that

90 percent of the fractures in older women are associated with little or no trauma [76] underscores the importance of prevention of osteoporosis to decrease the incidence of fractures in the elderly.

Falls

Falls are a significant problem for the elderly. Snipes [77] has estimated that 15–40 percent of the elderly suffer at least one fall, with many more "relatively trivial" falls going unreported. The risk of fractures associated with falls increases with age and for females. Depending on the population studied, 8–40 percent of falls sustained by the noninstitutionalized elderly resulted in fracture [78]. Estimates by the U.S. Public Health Service indicate that two-thirds of the falls by the elderly may be preventable. Obviously, falls have many causes, necessitating intervention into numerous aspects of the older person's life. Medical, environmental, and social factors all play a part in the occurrence of falls in the elderly.

As many as half of the falls sustained by the elderly may be caused by environmental factors [77]. Structural hazards, such as broken stairs, icy sidewalks, inadequate lighting (both inside and outside), torn or frayed rugs, and electrical cords, cause a great many unnecessary falls in the elderly. The increased risk of accidents in the elderly may be related to poverty and a consequent need to live in neighborhoods with broken or substandard facilities and higher rates of crime and vandalism [79]. Fear of crime may cause the elderly person to stay indoors or to watch for criminals instead of hazards in the path. Impaired vision or improper glasses may prevent an elderly person from seeing obstacles. In addition, improper clothing or shoes may impair mobility and cause the elderly person to trip. Inadequate foot care is an underestimated problem in the elderly and may contribute to senile gait disorder.

Syncope (unexpected loss of consciousness), orthostatic hypotension (dizziness resulting from a sudden drop in blood pressure on standing), and vertigo may signify an underlying medical condition, which can be treated to prevent the increased chance of falls. Parkinson's disease, seizures, and cerebrovascular disease have also been associated with falls among the elderly [80]. Appropriate diagnosis and treatment of these illnesses in the older population may eliminate underlying causes of falls.

Inappropriate or excessive medication may also cause falls. The drugs implicated most frequently include sedatives, hypnotics, psychotropics, and anticonvulsive agents, as well as antihypertensives [77]. A

study to determine the relationship between barbiturate use and falls concluded that, in 93 percent of the falls observed between 10:00 p.m. and 6:00 a.m., the patients had taken a barbiturate [81]. The need for caution in prescribing drugs becomes apparent.

Many elderly persons fall because of unfamiliar environments, as exemplified by the high proportion of falls occurring during the first week, especially the first day, of admission to a long-term care facility [82]. This may be caused by many factors, including the inability to compensate for poor vision in an unfamiliar environment or the general confusion that accompanies a move and a significant change in life-style. (Anecdotally, falls are a high risk early in moves to new apartments as well, but no systematic figures are available.)

Osteoporosis

Several factors play a role in bone fracture: the presence of osteoporosis, decreased remodeling rate of bone, frequency and extent of trauma, and instability. Hui and his colleagues [83] have estimated that low bone mass, associated with osteoporosis in elderly women, is probably the greatest determinant of fracture. The causes of osteoporosis are not well understood, but it appears to be caused by an increased loss of bone mass in aging associated with an increase in bone resorption and a decrease in bone formation. The various endocrine changes occurring at menopause are likely to augment the propensity for osteoporosis. A decrease in estrogen levels results in an increased sensitivity to bone resorbing agents (for example, parathyroid hormone). When this is combined with the decrease in calcium absorption often seen postmenopausally, the result may be osteoporosis [84]. A decrease in the level of 1.25-dihydroxycalciferol, which enhances calcium absorption, is often seen, along with an increase in parathyroid hormone [74]. The decrease in the level of immunoreactive calcitonin is thought to slow the reformation of bone [85]. Administration of estrogen appears to be the most efficacious method of arresting loss of bone mass, probably mediated through calcitonin [86]. Estrogen alone does not reverse the symptoms of osteoporosis, however, and is usually given in combination with Vitamin D, calcium, and fluoride.

The treatment of osteoporosis with estrogens, even in low doses, is not without its risks, and adverse side effects such as an increase in vaginal bleeding and endometrial cancer are significantly more frequent in women taking estrogens. The addition of progesterone to the estrogen cycle, from 7 to 13 days, appears to decrease the incidence of endometrial cancer [87]. In addition, frequent screening for signs of

endometrial cancer have resulted in detection at an earlier stage, with more favorable prognosis.

A recent recommendation by the AMA Council on Scientific Affairs [88] indicates:

> There is general agreement that women who undergo *premature* menopause should receive estrogen replacement, at least up to the average age of menopause to retard the early onset of bone loss. The election of estrogen replacement for this purpose in the normal menopausal patient can be based only on assessment of the relative risks and benefits applicable to the individual patient. The duration of such treatment is also a matter of individual judgment. (p. 359)

The risk factors for osteoporosis include genetic, medical, nutritional, and social factors. Early age of menopause, a history of diabetes, and use of corticosteroids have been associated with a greater risk for osteoporosis [89]. Decreased calcium and vitamin D intake and lactose intolerance have also been associated with a positive risk ratio for osteoporosis [90]. Immobilization or decreased physical activity and low levels of exposure to sunlight have also been associated with osteoporosis [91]. The preventive management of osteoporosis, which should begin at menopause, includes exercise, low dosage of vitamin D supplementation, and increased calcium intake [74, 92].

The efficacy of the preventive and treatment courses of therapy for osteoporosis have not been subjected to many prospective clinical trials because of the nature of the disease. Osteoporosis is characterized by long asymptomatic periods, and the clinical course of the disease is variable. Most patients who have diminished bone mass do not develop fractures, and many women treated for osteoporosis still develop fractures [90]. Unfortunately, much more must be known about the specific risk factors for osteoporosis and the risks and benefits of long-term therapy before a large-scale program of prevention can begin.

Rehabilitation

Estimates of the outcome of hip fracture may be measured in several ways: mortality, the proportion of patients requiring institutionalization, and the proportion of patients requiring assistance with activities of daily living. Depending on the population studied, 1-year mortality rates from hip fracture range from 12 to 67 percent, with the lowest mortality in patients who were independent and fully functional prior to fracture and highest in patients who were institutionalized and already frail [76]. Keene and Anderson [93] have developed a functional rating scale to predict the likelihood of institutionalization after

hip fracture. Important risk factors include impaired mental status, inability to walk 2 weeks postoperatively, inability to perform ADL unassisted, and living alone or in an institution prior to fracture. In their study, 41 percent of patients with hip fracture were discharged to nursing homes; however, 9 percent were able to resume independent living within 1 year. Ceder, Lindberg and Odberg [94] estimate that 75 percent of all surviving patients with hip fracture could be discharged directly home, with another 10 percent discharged home after temporary institutionalization.

Perhaps the most important factor in recovery from hip fracture is a total rehabilitation program, which includes both physical and occupational therapy [75]. Early fixation of the fracture, early mobilization, and early weightbearing appear to be instrumental in successful rehabilitation and prevention of loss of independence. In a study comparing early (1 day postoperatively) and late (2–3 weeks postoperatively) weightbearing, length of stay was found to be considerably shorter (27 versus 44 days), and a greater proportion of patients were able to be discharged directly home with rehabilitation utilizing early weightbearing [95].

After hip fracture, patients generally require more assistance with ADL even after receiving intensive rehabilitation. A greater proportion of patients are able to return home if they live with someone else; this is due to a combination of the physical assistance and psychological support provided [95, 76]. In a study assessing hospital rehabilitation 1 year after fracture, the proportion of patients utilizing some form of home-help services increased from 29 percent before fracture to 62 percent [95]. While specialized rehabilitation clinics provide a more intensive level of rehabilitation than do nursing homes, one study concluded that patients discharged from specialized rehabilitation clinics ultimately used more social services such as Meals-on-Wheels and home help than did patients discharged from nursing homes after rehabilitation for hip fracture [96]. Simply determining the utilization of services is not an optimal way to determine the functional ability of elderly persons, however. While the provision of social services may signify a loss of function to the client, it may also signify a greater ability on the part of the rehabilitation clinics to return patients to the community with less functional ability. If the rehabilitation clinics are able to discharge patients to the community who would otherwise be institutionalized, even the increased use of social services will not detract from the financial savings and improved quality of life of the elderly patient.

The sparse data on rehabilitation after hip fracture leaves one with

many unanswered questions. It is not clear what the differences are between patients who benefit greatly from rehabilitation and those who do not, or whether those differences can be modified. While the intensity and setting of rehabilitation may be important in aiding functional recovery, few studies have compared results by randomly allocating patients to different rehabilitation programs. Clearly, much more research is needed before we can determine the most effective way to prevent much of the disability and institutionalization resulting from hip fracture.

INFECTIOUS DISEASES

While infectious diseases have declined dramatically as a major cause of mortality in the United States during the last century, many still constitute serious health hazards for the elderly. In 1977, influenza and pneumonia were listed as the fifth leading cause of death in the general population, but the fourth among the elderly, accounting for a mortality rate of 170 per 100,000 elderly persons. More than 50,000 deaths a year are attributable to pneumonia, more than half of these occurring among persons age 65 and older [97]. The risk of death from pneumonia for persons age 65–74 is 2.5 times higher than that for the population as a whole and ten times greater for persons 75–84. Underlying medical conditions greatly affect a patient's susceptibility to and mortality from pneumonia [98]. The annual incidence of institutionally acquired pneumonia in the elderly is 100–115 per 1,000 patients as opposed to 25–44 per 1,000 for older persons in the community. Influenza and tuberculosis are two other major health concerns for the elderly. Because pneumonia is often a consequence of influenza [99], early prevention should concentrate on reducing morbidity associated with influenza.

The age-specific attack rate for tuberculosis is highest among those 65 and older [100]. Tuberculosis has been increasing recently among the hospitalized and institutionalized elderly [98], signifying a relaxation of previous conscientious preventive strategies.

Primary prevention of infectious diseases involves enhancing the body's natural barriers to disease. The decreased skin thickness and altered mucosal membranes that accompany aging make the older person more susceptible to infection, as does the decreased immune response. Malnutrition has been linked to immune deficiency [101], possibly because of a reduction in body vitamin or zinc concentrations [98]. Not enough is known about the various roles of these nutrients at

present to recommend a specific diet for the prevention of infectious diseases.

The Public Health Service has recommended influenza vaccinations for populations at high risk, but only 20 percent of the elderly receive these vaccines [102]. Several studies have concluded that pneumococcal pneumonia vaccine is more cost-effective for the elderly [103, 99]. At the same time, several questions have been raised about the efficacy of these vaccines in the elderly. The elderly show a poorer antibody response than do younger people and thus do not respond as well to vaccines [98]. Preliminary trials of the pneumococcal pneumonia vaccine showed a 75–95 percent efficacy in young, healthy adults. More recent evidence shows a mean efficacy closer to 36 percent when the elderly population is considered [104]. More evidence is needed before vaccination can be recommended as a national program for the prevention of pneumonia in persons at high risk.

GENERAL BEHAVIORS

Many chronic diseases have been associated with personal habits and, conversely, each of these habits may be associated with several diseases. Although many of these behaviors have been discussed in the previous section in relation to specific diseases, we review them briefly here to highlight target behaviors as a group. In general, the evidence linking behavioral changes to reduced risk of disease is fragmentary at best. The most dramatic exception is cigarette smoking, which has been shown to be a risk factor in several cardiovascular diseases and a variety of cancers, as well as in overall mortality.

A number of other behaviors without evidence of clear-cut benefit in any given disease may nonetheless be worthy of encouragement because they are more likely to do good than harm [105]. Some offer a direct benefit by increasing a sense of well-being or social participation. Others involve some sacrifice of immediate gratification. All are potential vehicles for exploitation, especially economic exploitation of the economically marginal elderly.

SMOKING

Although the risk ratio for overall mortality and morbidity from cardiovascular disease decreases with advancing age, the absolute number of deaths directly caused by cigarettes continues to increase [106]. In a study to determine the smoking habits and related mortality of a

defined population, Scholl [107] estimated that one-third of all deaths occurring in men age 50–60 could have been avoided if all smokers had quit at age 50. While decreases in the incidence of lung cancer are not seen until several years after cessation, coronary heart disease, chronic bronchitis, and emphysema exhibit a rapid turnaround in rates with smoking cessation. Some evidence points to a decrease in mortality after quitting for 1 to 4 years in men aged 50–69 [11]. While the benefits of smoking cessation should not be extrapolated to the elderly from studies done on middle-aged men, the evidence suggests a reduction in risk with cessation in the elderly. Much more research is needed to examine the benefits of cessation in the elderly.

DIET

Dietary modifications include a wide variety of changes from caloric restriction to adding or deleting specific components. The dangers of obesity have probably been exaggerated, and no compelling evidence is available to support active weight reduction in the elderly except those well above (50 percent or more) ideal body weight. At the same time, there are benefits to be had from becoming less obese; these include improved self-image and reduced stress on joints. Because a general reduction in caloric requirements is associated with aging, further reduction may be difficult for those who need it most.

Reduced intake of specific constituents usually means limiting salt and saturated fats. The evidence of benefit for the latter has been discussed under the cardiovascular diseases. Sodium reduction is sensible but often difficult, especially if the older person is relying on prepackaged foods or meals at congregate meal sites. The Food and Drug Administration is currently negotiating with the food industry to reduce sodium content in packaged foods and to label such foods more accurately [108].

Dietary supplements raise special concerns. Most elderly females probably require more calcium than is readily available in their diet. The recommended daily allowance of calcium is likely too low. Some authorities would also recommend vitamin D. Inexpensive supplements are indicated to prevent osteoporosis. In contrast, there is no good evidence to support the widespread use of general-purpose vitamins. The elderly seeking longevity and vitality may be especially vulnerable to the promises of those making unsubstantiated claims for large doses of these substances. Schneider and Nordlund [109] canvassed community-dwelling elderly in Ohio and found that about half of their sample were using some kind of vitamin or mineral supple-

ment. Use was directly correlated with age and *inversely* correlated with income. In only half of the instances was the supplement recommended by health care providers. The authors also discuss two common misconceptions: that the value of the supplement increases with its price and that the larger the dose the more beneficial the result.

EXERCISE

Exercise in moderation makes good sense for elderly persons. Although its role in preventing heart disease and controlling arthritis in this age group is unclear, several studies have shown positive physiologic responses to exercise in elderly subjects [110, 111]. A growing body of reports suggest that exercise may have a positive role in delaying osteoporosis, but the results to date cannot permit a definitive recommendation [112, 92, 113]. Some authorities have advocated a position of "use it or lose it" [114], a concept that has more intuitive appeal than supportive evidence. Short of this extreme position, a daily program that emphasizes activity makes intuitive sense in promoting physical and mental function. However, in a 1978 Harris poll, 70 percent of persons over 50 years old reported that they did not exercise regularly [111]. In light of the multiple complications of immobility and the sense of well-being and opportunity for group participation, a moderate exercise program for elderly persons should certainly be encouraged.

STRESS AND ISOLATION

Two other classes of behavior merit attention: stress reduction and socialization. Much has been made of the relationship between stress and susceptibility to disease. Social support has been shown to be a protective factor in reducing the impact of such stress.

Social isolation on its own has been identified as a risk factor for subsequent mortality. A 9-year follow-up study of Alameda County residents identified an inverse relationship between the number of social connections and relative risk of mortality [115]. However, Blazer [116] found that the elderly person's perception of available social support was more predictive of mortality than were objective measures of socialization. Individuals faced with combined stresses, as in widowhood, are at a particular disadvantage. The higher mortality rate among widowers compared to widows has been attributed to the lack of adequate social support among widowers [117]. A study of social support among elderly persons identified a large sex difference in the number of confidants among the widowed. Of those surveyed, 33

percent of widowers reported no confidants; 25 percent reported two or more confidants. Only 18 percent of widows reported none, and 54 percent reported two or more confidants [118].

These observations have prompted a number of stress-reduction programs, several targeted at the elderly. Although the anecdotal data from these activities are enthusiastic, clear scientific evidence of reduced risk is not yet available. In the case of social isolation, the problem is more complex. There is no basis for anticipating benefit from socializing individuals who have pursued an isolated life-style throughout most of their adulthood, but those recently isolated by bereavement or other loss may indeed be helped. Again, however, clear evidence of such benefit is not yet available.

CLOSER ATTENTION IN THE COURSE OF HEALTH CARE

As they age, the elderly are more likely to suffer from chronic impairment, if only by virtue of their greater exposure to various risks. Many of these impairments are unglamorous but have substantial effects on function. An important part of any plan for prevention, then, should include more careful attention to those functional incapacities that can be corrected or compensated for.

Probably the best examples of such neglected conditions are hearing, vision, and dentition. Each of the organ systems involved can dramatically affect an elderly person's functioning; substantial portions of each are amenable to direct corrective intervention. Such attention is consistent with the principles of secondary prevention, but the level of screening may be more appropriate in combination with routine medical care than as the subject of any special activity. As such, it fits the general model of the periodic health examination described by the Canadian Task Force [119]. It is ironic that expensive mass screenings are recommended, while persons under regular care fail to realize the benefit of a careful review of their problems.

The elderly are at high risk of neglect in the course of ordinary care. Data taken from the 1971–75 Health and Nutritional Examination survey suggest a different pattern of preventive attention to persons age 65 and older compared with those 35–64. During a checkup, the elderly were more likely to have a cardiogram and chest x-ray and less likely to have vision and hearing tests [120]. Anecdotally, patients complain that physicians fail to listen to them and to explore their specific functional complaints.

The need for closer attention is not limited to the physician or other primary-care givers in an ambulatory setting. In long-term care facilities where nursing surveillance is routinely available, it is still possible for correctable problems affecting functioning to be missed. And oddly, even in hospitals where full diagnostic workups are implemented, the eyes, ears, teeth, feet, and psyche may all go unnoticed. Crude estimates about the prevalence of preventable disability among the elderly can be gleaned from the experiences of special geriatric assessment teams in the United States and other countries. Whether the assessments were done on an inpatient or outpatient basis, an average of three correctable problems per patient were identified; these were about equally divided between functional and medical conditions [121].

We turn our attention specifically to exemplary conditions where increased physician (or other primary-care giver) sensitivity to a possible condition could lead readily to direct intervention and thus to improved function: vision, hearing, dentition, depression, alcohol abuse, and insomnia.

VISION

Visual deficits are common among the elderly. The prevalence of eye conditions exceeds 85 percent among persons age 65–74 [122]. Almost 60 percent of persons in that age range have cataracts; 5 percent have glaucoma (Table 6). As shown in Figure 3, the prevalence of unattended treatable eye pathology rises in old age.

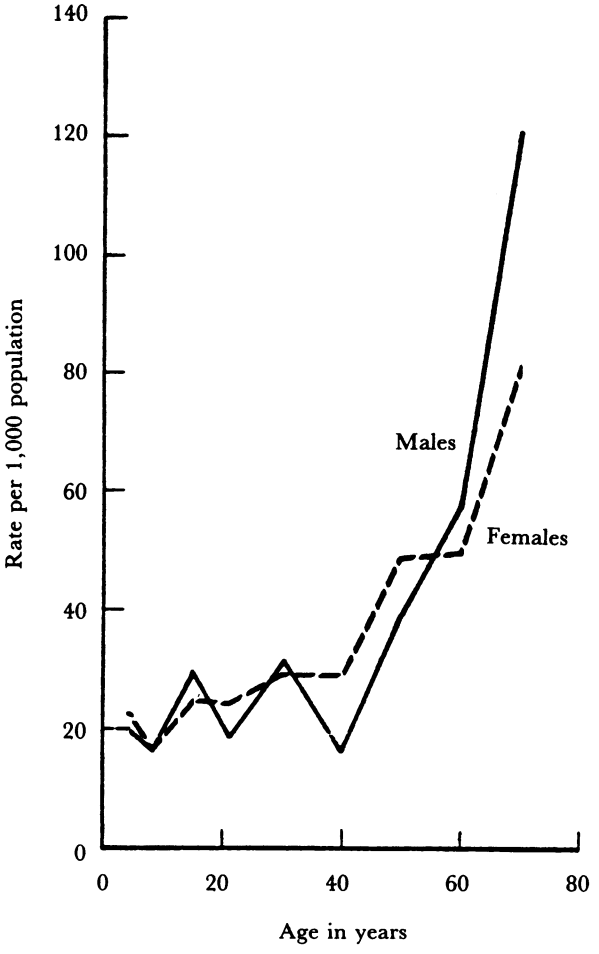
There is little increase with age in the prevalence of refractive problems. Cataracts, however, tend to be overlooked, and appropriate correction may be unduly delayed. For persons who will be left with residual visual impairment after all feasible corrections are applied, a possibility remains for minimizing dysfunction and secondary prob-

Table 6: Prevalence of Selected Visual Problems in the Elderly

	Rate per 1000	
Visual Problem	*55–64*	*65–74*
Refractive error	2	3
Cataract	78	53
Glaucoma	276	576

Source: [122].

Figure 3: Prevalence Rates for Eye Pathology Needing (But not now Receiving) Medical Treatment Among Persons Ages 1-74 Years, by Age and Sex: U.S., 1971-72



Source: see Reference [122].

lems (injury, reduced quality of life, social isolation, anxiety) by referral to a variety of resources for the partially sighted and by giving the individual information about resources that range from equipment for protection against crime to entertainment for the partially sighted. Practitioners note that the peculiar fragmentation of services for the old, social services for the needy, and services for the blind and partially sighted mitigate against enabling the elderly with visual problems to tap into the specific remedial resources.

HEARING

Hearing is critical to functioning. Persons who cannot hear cannot communicate effectively. They may be dismissed as cognitively impaired, especially if they are old. As part of the National Health Examination survey in 1974–75, a sample of persons was tested for ability to discriminate speech. While 91 percent of the 25–34-year age group missed no more than 5 words from a 50-word list read at 20 decibels, only 33 percent of those age 65–74 could perform as well. With amplification to 50 decibels, the failure rate among the elderly fell to less than 10 percent [123]. In 1977, 16 percent of persons age 65 and older reported that, at best, they could hear shouted speech, but only 37 percent of those individuals used a hearing aid [124].

Scant information is available about the amount of excess disability that can be prevented by hearing aids. Moreover, hearing aids often require considerable adjustment before the level of functional results and comfort is sufficient to encourage the user to wear them. The high costs of hearing aids, the lack of Medicare reimbursement, and the often fraudulent marketing techniques that characterize the hearing-aid industry conspire against optimal prevention of hearing dysfunction.

DENTITION

Dentition is another area of functional neglect. Teeth—either real or prosthetic—are important for eating and speech, as well as for overall appearance, self-esteem, and social participation. The 1971–74 Health and Nutrition Examination survey found that only 40 percent of those age 65–74 had no edentulous arches; in over 45 percent, both arches were edentulous [125]. In that same survey, 25 percent of elders needed full dentures, 8 percent needed repair of dentures or bridges, and 23 percent needed repair of bridges or partials.

It has been estimated that almost one-third of the population is likely to lose remaining teeth between the ages of 50 and 70; the major cause of loss of teeth is periodontal disease [126]. Limiting dental care to symptomatic problems has not proved effective in preventing dental and periodontal disease. Rather, studies have shown that improvement in oral hygiene and maintenance of proper plaque control procedures are effective in preventing both dental caries and periodontal disease in adults [126, 127, 128]. However, most of the educational material on preventive dentistry and good oral hygiene is designed for children and young adults, giving the impression that preventive dentistry is for the young. Because decreased saliva production is associated with aging and exacerbated by various medications, the elderly are at special risk for dental caries. Stannous fluoride gels similar to those used with children may have a preventive role here [129].

At present, the elderly do not receive sufficient preventive or therapeutic dental care. In 1980, a community survey found that persons age 65 or older were significantly less likely than younger persons to have visited the dentist recently. The elderly, especially those age 75 and older, were more likely to report dental problems but less likely to support statements about the efficacy or affordability of dental care [130]. Although some of these differences may be attributable to cohort effects, the economic issues are especially germaine in light of the absence of Medicare coverage of most dental services. Even when the primary caregiver makes the appropriate recommendation and referrals, the high cost of dental care is often a deterrent to further action in preventing the dysfunction related to correctable dental problems. In long-term care facilities, loss or improper care of dentures and lack of attention to ill-fitting dentures is believed to be a substantial problem, but no data are available on the extent of such problems or their actual consequences.

DEPRESSION

Depression can be viewed as an archetypal condition in the primary care of the elderly. Its symptoms are vague and often explainable by the numerous exigencies associated with growing old. Once recognized, depression can be managed effectively by counseling, chemotherapy, and social intervention. The critical step is to recognize the existence of the problem.

Solomon [131] estimates that 30–50 percent of the elderly will undergo a period of depression severe enough to interfere with their daily functioning. Blazer [132] cites a prevalence range for depression

in the elderly population of 5–65 percent, depending on the characteristics of the population surveyed. One of the correlates of depression—suicide—shows a distinct age relationship. Studies have shown that suicide attempts may be higher in other age groups, but males over age 75 are most likely to succeed.

Although many epidemiologic studies have shown that depressive symptoms show an increase in incidence and prevalence and a decrease in duration with age, data from the National Health Examination survey show no increase in prevalence with age [133]. The differences may lie in the measures used to identify depression. Clinical depression, however, maintains approximately the same rate of incidence, prevalence, and duration with increased age [134]. A study by Freedman, Bucci, and Elkowitz [135] shows that depressive symptoms exhibit an inverted U-shaped curve, peaking in the early midrange of the aging process. Whether the peak signifies a survival of the fittest or an "old-age crisis" with adaptive significance, the "young" elderly appear to be at especially high risk.

Depression in the elderly is a serious problem in the United States, but unfortunately, it is a difficult one to diagnose. Clinicians often have difficulty distinguishing clinical depression from depressive symptoms arising from the normal process of grief caused by loss and by the stresses of later life associated with illness and changes in lifestyle [132]. In addition, the symptoms of mental and physical impairment are difficult to separate—they often present with the same complaints and may cause or exacerbate each other [136, 137]. Depression is often seen as a natural and inevitable component of aging by the patient, the family, and the physician, and not as one that it is necessary to treat [135].

Depression is characterized by a depressed or sad mood, poor or markedly increased appetite, insomnia or hypersomnia, loss of energy, physical agitation or retardation, decreased sexual drive, feelings of guilt, diminished ability to think or concentrate, and suicidal ideation [134]. The symptoms of depression are nonspecific, and many are usually thought to be associated with the aging process in general. Feelings of sadness or hopelessness and many of the physical symptoms of depression often accompany physical illness as well [138].

A prevention strategy for depression, with its nonspecific and common symptoms, must be able to characterize the population most at risk and to concentrate the bulk of resources on that group. The elderly whose normal coping mechanisms are compromised by a series of overwhelming stresses, a breakdown of their normal support network, or serious organic disease, appear to be at high risk for depres-

sion [131]. Illness or injury associated with distinct changes in body image, such as stroke or amputation, or those that provoke greater anticipation of further disability or pain, such as cancer, place the patient at especially high risk for depression. Studies have shown that as many as 85 percent of elderly persons who commit suicide had an active physical illness at the time [138]; but given that high proportions of the elderly have physical illnesses, such findings are hard to interpret. Epidemiological work describing the types and severity of illnesses associated with suicide risk in the elderly would be useful.

It is difficult to determine, however, if physical illness and inadequate social supports are risk factors for or manifestations of depression. Stress and emotional factors can precipitate physical illness, but the reverse is also true [136, 137]. One study of depression in nonsymptomatic elderly community residents indicated that about 25 percent had scores suggesting moderate to severe depression [135]. It is unclear whether this signifies that depression is endemic in the elderly and is severely underdiagnosed or whether scale scores should be interpreted differently for the older age groups.

ALCOHOL PROBLEMS

Given the dramatic physiological and psychological changes associated with aging and the cultural use of alcohol to escape from problems, one might expect to find a significant number of alcoholics or problem drinkers among the elderly. Estimates of the prevalence of older problem drinkers range from 7 percent [139] to 20–30 percent [140]. While alcoholism is serious at all ages, three aspects are particularly pertinent in the elderly: (1) adverse synergistic effects of medication and alcohol, (2) potentially serious consequences of accidents in the elderly, and (3) misdiagnosis of alcohol problems as "senility" [140]. Finally, there appears to be an association between mortality and morbidity and chronic drinking; chronic drinkers are more likely to be institutionalized than are nondrinkers [139].

Elderly alcoholics are not a homogenous group; two-thirds of the elderly alcoholics began as early alcohol abusers, while one-third suffer from situational or late-onset alcoholism [141]. Intervention strategies are necessarily different for the two groups: because of its situational, problem-oriented nature, late-onset alcoholism generally improves with intervention to strengthen coping mechanisms and provide socialization and interaction with peers. The geriatric early-onset alcoholics appear to do better in treatment programs than do younger alcoholics; in general, they tend to be more responsive and enthusiastic [141].

Problem drinking is a potentially serious problem in the elderly. While no method has been developed to prevent alcoholism, some preventive measures can be taken to lessen the negative impact of alcohol. Socialization and counseling may help minimize the problems faced by the elderly and increase their capacity for coping. By enabling the older person to deal with his/her problems in a constructive manner, it may be possible to prevent late-onset alcoholism. In addition, through education about the physical problems that may be caused or exacerbated by alcohol, such as sleep disturbances, sexual dysfunction, drug interactions, and decreased mental abilities [140], it may be possible to sensitize the older person and prevent alcohol abuse.

SLEEP DISTURBANCES

Elderly persons appear to be especially prone to insomnia, although no good statistics are available. They often complain of spending more time in bed, either trying unsuccessfully to sleep or lying in bed without attempting to sleep. Awaking after sleep onset also appears to be much more frequent in the elderly, although total sleep time remains the same. Some of the causes of insomnia in the elderly include higher rates of anxiety, depression, and discomfort caused by changes in lifestyle and chronic disease, chronic pain, and other medical conditions. Excessive dosages of medications may prevent sleep or disrupt the normal sleep cycles, causing a person to feel that he or she has not slept enough. The alteration of normal rest/activity cycles that can accompany retirement and illness and the decrease in the amount of exercise performed may increase the lethargic feeling of the elderly person. Finally, the crowding and noise often found in hospitals and institutions may produce insomnia in the elderly.

Treating anxiety and depression through counseling and drugs may help to alleviate insomnia. Providing medication for the relief of pain may induce sleep, but it may also create other iatrogenic problems. The most effective and safest way to prevent or alleviate insomnia in the elderly seems to be through increased daytime activity, including both physical and mental stimulation. The use of sleeping pills and other sleep-inducing medications should be reserved for situational insomnia.

Sleep disturbances illustrate the difficulty in even defining the medicosocial problems associated with old age. To the extent that insomnia is discomfiting to the individual concerned, preventive efforts are warranted. Other sleep disturbances such as night wakefulness and agitation among those with senile dementia require treatment

for the physical and mental health of family members. But, in other instances, especially in residential settings, irregular sleep patterns may be defined as a problem when their major effect is only to disrupt staff routines. In such situations, administration of sleeping pills is likely to do harm, whereas tolerance of night prowls and provision of the opportunity to be awake and occupied at night without disturbing others may be the optimal solution.

INTERVENTIONS TO INCREASE ATTENTION

Because impairments and disabilities of the elderly can be averted or minimized by closer attention in the course of medical practice, a logical preventive strategy is to intervene to change the risks for inattentive health care. The approaches usually considered are educational.

Educational efforts, in turn, have several possible targets. One obvious focus is the health professional, who can be given tools to facilitate thorough assessments and who can be socialized or resocialized to recognize the potential for functional improvement in older patients. A second target group is the elderly themselves, who can be taught skills to help them gain the most from their encounters with health care professionals and minimize the likelihood of iatrogenic impairment. Older people may be taught more effective ways to describe and classify symptoms, how to be assertive in medical encounters, how to prepare their questions, how to keep records of medications, how to select physicians, and how to seek second opinions. A third target group in a more diffuse campaign would be the general public of all ages. Here the endeavor would be to eliminate negative, defeatist age stereotypes and substitute a positive image of older people.

Recent studies of how older people perceive and report health problems suggest the premise of direct approaches to the elderly themselves [142, 136, 137]. Subjects in these studies kept records of their health problems over a defined time period. Those problems occasioning the most distress were usually functional and generally were *not* reported to physicians. When the same subjects were given checklists of symptoms, they reported experiencing other symptoms not elicited in the open-ended method. Most common among potentially serious symptoms not perceived as such by the subjects were chest pain, shortness of breath, dizziness, trouble passing urine, and forgetfulness. Several reasons have been postulated for the underreporting of some symptoms by the elderly. These include the acceptance of declining

physical health as a symptom of normal aging, doubt regarding the possibilities for relief or cure, ignorance about the significance of the problem, and an unwillingness to bother their physicians [143].

A handful of projects have sprung up directed at enhancing the skills of older people in negotiating the health care system and ensuring adequate attention to their problems [143–147]. As yet, these programs, which vary in specific target group, educational approach, and auspices, have had no systematic evaluation to determine whether they can indeed change the risks that common problems be neglected by health care providers. Similarly, numerous programs have been developed to sensitize (sometimes referred to as "gerontologizing") health care professionals as well as to provide core training for doctors, nurses, and other professionals who want to specialize in caring for the old.

IATROGENESIS

Iatrogenic illnesses, i.e., those illnesses or conditions arising from medical care, are probably the most common preventable disease in old age. Because the elderly utilize significantly more medical resources than does the general population and because of the narrow therapeutic window mentioned earlier, they are especially prone to iatrogenesis. The most common types are drug reactions, nosocomial infections, and loss of the ability or opportunity for independent social functioning.

DRUGS

Many iatrogenic problems can be prevented or minimized by careful prescribing for and surveillance of patients taking multiple medications [148]. Elderly persons constitute 11 percent of the population, yet consume 25 percent of the drugs sold in the United States; it is not surprising that their rate of medication side effects is 1.5 to 3 times that of younger persons [149]. Data from the National Ambulatory Medical Care Survey indicate that those 65 and older are more likely than those younger to get drugs for each of a variety of common diseases; the difference is especially striking in the case of visits for neurotic depressive disorders [150].

In addition, the elderly use a disproportionately large number of over-the-counter (OTC) drugs; 70 percent regularly use OTC medications, compared to 10 percent of the general population [151]. The use

of aspirin increases with age. By age 65, 30 percent of persons in the National Health Interview Survey reported using aspirin once a week or more—over twice the rate for persons age 20–24. The use of sleeping pills is seen more steeply related to age. Over 12 percent of those age 75 and older use sleeping pills once a week or more compared with less than 2 percent of those age 20–24 [152].

Some iatrogenic medication effects are the result of improper dosage; others are side effects (see Table 7). Careful management and prompt recognition are important steps in geriatric pharmacotherapy. Unfortunately, most of the preliminary trials of drugs are done on young subjects; there are no clearcut guidelines available for the different prescribing practices necessary for elderly patients. High rates of noncompliance—up to 60 percent or more—complicate the picture even further.

Falls and injuries can arise from overmedication. Many medications, alone or in combination with others, cause dizziness, visual disturbances, and sedation, which may cause the elderly person to fall. Sedatives, hypnotics, psychotropics, anticonvulsive agents, and antihypertensive drugs have all been implicated as causes of unnecessary falls and injury in elderly patients [77]. There is an especially strong relationship between the use of sleeping pills and falls during the night [81]. Minimizing the doses of such medications or ensuring that the patient has help or supervision can prevent such accidents.

The physiological changes with aging may alter the effects of drugs in the elderly. There are two main theoretical approaches to the different drug actions in the elderly. The pharmacodynamic theory states that the same concentrations of drugs will evoke a greater response at the receptor site in older than in younger persons. The theory of age-related changes in drug disposition incorporates the physiological changes associated with aging into the pharmacokinetic parameters for the drugs [153]. Drug distribution may be affected by the increase in total body fat, decrease in total body water, and the decreased serum albumin concentration. These changes translate into decreased plasma concentrations of fat-soluble drugs, increased concentrations of water-soluble drugs, and an increased concentration of unbound drugs in plasma [154, 153]. The reduction of renal function associated with aging means slower clearance of the drug from the body. In addition, the decreased hepatic blood flow and enzymatic activity can result in decreased metabolic degradation, which may lead to higher plasma concentrations [153].

These differential effects of drugs in the elderly suggest several strategies for the prevention of iatrogenic disease caused by drug toxic-

Table 7: Examples of Common Drug Side Effects

Drug Categories	*Common Side Effects*
Anticholinergics	Confusion, disorientation Blurred vision Dry mouth Palpitations Urinary retention Constipation
Antiadrenergics	Sedation Depression Orthostatic hypotention
Vasodilators	Pounding headache Hypotension "First dose syncope"
Diuretics	Excessive dehydration Hypokalemia
Antiarrhythmics	Cardiac depressant effects Prolongation of conduction time Delayed repolarization
Tricyclic antidepressants	Sedation Orthostatic hypotension Prolongation of conduction time
Phenothiazine tranquilizers	Sedation Orthostatic hypotension Extrapyramidal side effects Tardive dyskinesia
Analgesics	Ulcerogenic potential Impaired platelet aggregation
Antimicrobials	Nephrotoxicity Ototoxicity
Antacids	Increased sodium intake Mental confusion Slurred speech
Laxatives	Laxative dependency
Hypoglycemics	Inappropriate antidiuretic hormone excretion Hyponatremia

Source: [149].

ity and adverse reactions. First, a careful assessment of the patient's complaints is necessary to determine that the new symptoms are not caused by the adverse reactions of medication already prescribed. Second, careful determination of the proper dosages is advised. If in doubt, one should begin with a prescription of 30–50 percent of the

dose recommended for a younger person [151] to reduce the chance of overmedication and the possibility of adverse reactions. The use of a family pharmacist to suggest proper OTC medications and monitor the different drugs taken by the elderly patient has been suggested as a way to counteract the possibility of different physicians prescribing different medications for the same patients. Third, all medications should be discussed carefully with the patient and family. Subjects to be discussed should include why the medication is being prescribed, the common side effects and contraindications. A "pill wallet" or medication chart is helpful for patients taking multiple medications [149]. Finally, careful reassessment of the appropriateness of medication on a periodic basis is essential. This might even include supervised "drug holidays" as an approach to differential diagnosis and starting over with a more tailored regimen.

The question of appropriate medication-prescribing behavior for the elderly has been addressed in several studies. Linn and Linn [155] determined that physicians prescribe different medications for young and elderly patients who exhibit the same symptoms; the elderly received more antihypertensives and analgesics, while the younger persons received more tranquilizers and anticonvulsive medications. Another study, looking at the appropriateness of diuretic therapy for 27 patients in a nursing home, discontinued therapy for all under observation and observed no hypertension or edema after a modest exercise program was instituted [156]. The results of these two studies suggest that physicians may stereotype patients and possibly do not take the necessary time to individualize their patients' medication regimens correctly. This has especially serious implications for the elderly, who often suffer from multiple conditions and are subjected to the practice of polypharmacy by their physicians.

NOSOCOMIAL INFECTIONS

Nosocomial infections, defined as those infections that develop during institutionalization and are not present or incubating at the time of admission, are also a serious health hazard to the elderly. It has been estimated that 5 percent of patients in acute hospitals in 1979 developed nosocomial infections [97]. Infection rates in skilled nursing facilities are somewhat higher, affecting from 3 to 18 percent of the residents [98]. The risk for nosocomial infections in the elderly is three times higher than that in the general population [100].

Urinary tract infections (UTIs) are a serious health hazard in the elderly. The estimated frequency of UTIs among elderly persons in the

community is 20 percent, while 30–50 percent of institutionalized elderly have UTIs. The risk of nosocomial UTIs in the elderly is two to five times greater than in younger patients [98]. The elderly with indwelling urinary catheters are at especially high risk of acquiring UTIs, and most preventive strategies have concentrated on that group. A recent study showed a 60 percent reduction in the incidence of infections when catheters with preconnected seals on the catheter-drainage tube junctions were used as opposed to nonconnected catheters [157]. This suggests that UTIs are caused by organisms that contaminate the drainage tube and bag. However, another study showed that the addition of chlorhexidine to catheter bags kept the contents sterile but did not reduce the risk of infection [158], suggesting that infections are caused by organisms in the patient's urethra after resistance to infection has been lowered by disease or surgery. It appears that much more research into the causes of UTIs is needed before a definitive prevention strategy, other than isolation and a sterile or clean environment, can be advocated for the prevention of infection in populations at risk.

DISABILITY FROM IMPAIRMENT

The goal of geriatric care is to restore maximal function. Ironically, conventional medical care may lead to the very opposite. Therapeutically imposed bed rest can lead to a "hypokinetic state," with losses of posture, balance, gait, metabolic balance, and cardiovascular tone [159]. Bed is thus hazardous to the health of the elderly.

More subtly, the protective nature of care may be antitherapeutic. An environment that tends to the needs of the patient can create dependency at the point when a pattern of self-care is critical. In institutions where staff are short-handed, the increased time demands of working with patients to encourage them to do things for themselves will too often mean that therapy is compromised. In an institutional or family environment where the care givers fear the possibility of accidents, the care may quickly become overly protective. Thus risk aversion may be viewed as a risk factor in the development of disability.

Unfamiliar surroundings and lack of stimulation, often encountered in the hospital, may also cause disorientation and impaired mental functioning, which may be mislabeled as senility [160]. The risk of institutionalization is much higher for elderly persons labeled as senile, and health professionals treat such patients differently than those who are believed to be cognizant. Prevention of senility "labeling" can be accomplished through careful medication of patients, maintenance of

social and mental stimulation, the avoidance of placing the patient in unfamiliar surroundings whenever possible, and, above all, professional caution in using the label, particularly based on a short period of observation when the patient is sick and in the hospital. In addition, the use of a colorful and stimulating environment in the hospital and institution, similar to that used on pediatric wards, can help in the prevention of disorientation of the elderly patient.

Impaired mental status in the elderly has a number of causes, and a quick diagnosis of senility has iatrogenic repercussions. Many medications cause confusion and sedation, which may be mistaken for senility; these medications include anticholinergics, antacids, tranquilizers, and barbiturates. Medical conditions such as depression, malignancy, hepatic disease, metabolic imbalance, and diminished cardiac output can also cause "pseudosenility" [161].

Ironically, the institutionalized elderly may also be among the most responsive to minimal intervention. For example, elderly nursing-home residents have responded dramatically when given a plant to care for [162, 163], a visitor [164], or a meaningful role as a tutor [165]. It has been suggested that pets would have a similar beneficial effect [166]. Excellent results are reported from a range of interventions designed to add interest or purpose to the lives of nursing-home residents.

Comprehensive rehabilitation and physical therapy can help minimize the losses of function that accompany long periods of immobility as well as the losses from the disease itself. Copp [167] has demonstrated the benefits of rehabilitation in mean gains in functional ability, both in the amount of gain and reduced dependency time.

NURSING-HOME ADMISSION

An important goal for prevention in the elderly is the prevention of unnecessary admissions to nursing homes. To pursue it, however, we need better information on the risk factors associated with a greater probability of admission (and particularly with greater probability of admission with a length of stay over 6 months). Table 8 summarizes the information now available.

Crude comparisons of the characteristics of nursing-home residents and community dwellers age 65 and over have been used as presumptive evidence of risk factors. Nursing-home residents are more likely to be older, unmarried, Caucasian, and female than are their contemporaries in the community. A similar strategy was used by the

Table 8: Risk Factors for Nursing Home Admission

Source	*Sample*	*Risk factors*
National Center for Health Statistics [188]	Survey of nursing home residents in 1977 (compared to those age 65 + living in the community)	Age, female, white, unmarried
Vicente, Wiley and Carrington (1979) [170]	Nine-year follow-up of residents age 55 + in Alameda County, California	Age, poverty, white, lack of social supports
Palmore (1976) [171]	Twenty-year follow-up of residents age 60 + in Piedmont, North Carolina area	Unmarried, white
Weissert et al. (1980a) [172]	One-year study of day-care recipients in controls in six sites	Primary diagnostic conditions, impairment prognosis, hospital outpatient or other ambulatory use
Weissert et al. (1980b) [173]	One-year study of homemaker recipients and controls in four sites; patients were hospitalized for at least 3 days during the 2 weeks prior to the study	Primary diagnostic conditions, ADL prognosis, bed disability prognosis, hospital outpatient or other ambulatory use
McCoy and Edwards (1981) [174]	National sample of welfare recipients age 65 +	Age, functional impairment, white, living alone or with nonrelatives, lack of social supports
Branch and Jette (1982) [175]	1,625 Massachusetts elders living in the community	Age, use of ambulation aids, mental disorientation, living alone, using assistance in ADL

General Accounting Office [168] to compare a sample of nursing-home residents in Durham, North Carolina, with community elderly in Cleveland. Using the Older Americans Resources and Services (OARS) Instrument measure of disability, the GAO report concludes that, for each nursing-home resident, three persons with equal levels of disability reside in the community. The validity of the comparison has been well challenged [169]. We would further caution against using data derived from the OARS to compare nursing-home residents to the

elderly in the community. OARS includes measures of economic and social impairment in its five categories, and these are certainly biased against nursing-home residents, almost by definition.

Vicente, Wiley and Carrington [170] used data from the Human Population Laboratory Longitudinal Study to follow those aged 55 and over for 9 years to assess their rate of nursing-home use. Factors more common in those with at least one admission were advanced age, low income, female gender, Caucasian race, and lack of social supports. Health status, measured as chronic limitation of activity, did not differentiate users from nonusers.

Palmore [171] followed a group of 207 elderly persons in the Durham, North Carolina area for 20 years. He found the probability of spending some time in a nursing home to be greater for women, whites, those never married, those without living children, and those with 6 or fewer years of schooling.

Weissert's [172, 173] analysis of the day-care experiment over the study year suggested that the patient characteristics significantly associated with entering institutions were: being white (as opposed to being nonwhite), having fewer social activities and more bed disability days, having a diagnosis of circulatory disorder or an injury, having functional limitations as measured by the Katz ADL scale (a 6-item measure of independence in feeding, bathing, dressing, toileting, transferring, and a measure of continence). A similar analysis on those from the homemaker portion of the experiment showed no significant associations, but this lack may be explained by the requirement that all participants had to have been hospitalized for at least 3 days during the 2 weeks immediately prior to their entry into the study.

McCoy and Edwards [174] used data from the 1973 Survey of Low-Income Aged and Disabled to predict 1974 institutionalization among welfare recipients aged 65 and over. They found the probability of institutionalization to increase with functional impairment (measured by a modified Katz ADL scale), advanced age, household isolation, presence in the household of nonrelatives, and white race. Probability of institutionalization decreased in association with measurable social support, including frequent contact with friends and relatives and the propinquity of children.

Branch and Jette [175] followed a cohort of elderly individuals living in the community over a 6-year period. They identified five variables significantly associated with subsequent admission to a long-term care facility, but the variables accounted for only 10 percent of the variance.

RECOMMENDATIONS FOR RESEARCH

Our research recommendations stem from a recurrent theme in this review. Definitive knowledge, especially of the elderly, has been in short supply, and almost every topic touched upon would benefit by systematic study. Indeed, it is easier to recommend research than to design practical yet definitive studies and to locate funds for the investigations.

Epidemiological work remains to be done. Much work is needed in traditional areas of epidemiologic study, such as heart disease, stroke, and cancer, to look for specific risk factors in the elderly, whereas other lines of research should begin to establish incidence and prevalence of functional disabilities.

USE EXISTING DATABASES

Whenever possible, we should mine existing databases for information about impairments or diseases that affect the elderly. The Framingham studies [8] and the Alameda County studies [176] are examples of longitudinal studies that can be used to address specific questions about risk factors for the elderly. These studies permit long periods of follow-up to establish the relationship between the existence and persistence of risk factors and consequent morbidity. A very promising follow-up of the National Health and Nutrition Examination study will emphasize geriatric commonalities [177]. Three new longitudinal panels have recently been organized under the aegis of the National Institute of Aging. These are designed to examine risk factors for a number of specific and general conditions. Now that the policies prohibiting enrollment of persons over age 65 in trials sponsored by the National Cancer Institute has been revoked, more effort needs to be directed toward examining factors associated with risk of recurrences in the elderly; special follow-up studies of existing panels may be useful here.

Longitudinal data following cohorts of frail elderly are rare. More typically, the available data sets follow young or middle-aged persons, and information about the elderly is limited to the upper-level age group of enrollees who may reach their sixties or seventies before the end of the data-collection period. Particularly useful are studies that follow elderly community-dwelling persons to determine characteristics of those who enter residential care. Some longitudinal data sets developed in Canada [178–181] have that capacity, although they are limited in the amount of medical data they include. Some community-based long-term care programs, including the ongoing National

Channeling Demonstration, will have similar capacity. Longitudinal data describing elderly nursing-home residents are particularly rare, and, with few exceptions [182, 183], are based on record review and/or care-giver impressions rather than direct examination of the subjects.

Existing data sets should be used but not misused. It is important to be appropriately skeptical of data (such as some nursing-home quality assurance data sets) that may be an accumulation of unreliable care-giver judgments. In the nursing-home sphere, it is also important to differentiate between data sets that describe residents and those that describe admissions. Cross-sectional data on residents underrepresent those with short nursing-home stays [184]. Using data on residents to develop epidemiological information about factors associated with various functional conditions may be misleading. Certain functional disabilities (e.g., confusion, incontinence) may be the result rather than the cause of nursing-home admission; yet unless cohorts of admittees are analyzed separately, such differences cannot be teased out. Other problems occur when programmatic data are used for epidemiologic studies. Incentives of the data collectors must be explored. For example, the new DRG (diagnostically related groupings) system for Medicare reimbursement has created incentives for the physician to record diagnoses that maximize hospital revenue.

EXPAND DATABASES

Databases should be expanded to include disabling conditions not usually followed. These include hearing impairments, vision impairments, and incontinence. For example, we know little about the natural course of incontinence because of failure to ask the right questions and social taboos, which militate against voluntary reporting of early manifestations. Numerous efforts have been launched to develop a uniform taxonomy of functional status and to add such information to national surveys like the Health Interview Survey of the National Center on Health Statistics.

INCLUDE ELDERLY IN INTERVENTION STUDIES

Elderly persons should be included in studies that examine the effects of preventive approaches such as diet control, weight control, stress reduction, hypertension control, cancer screening. Older people are inappropriately excluded with the best of intentions. Usual reasons given are that multiple diagnoses cloud interpretation of the data and that foreshortened life expectancy may make it difficult to study effects

fully. But to explore interventions with the elderly, it is important to be able to study the relationships in just those situations with multiple diagnoses. Elderly subjects included in intervention studies should be specifically stratified to differentiate those with long-standing from those with newly acquired risk factors.

CLARIFY SOCIAL RISK FACTORS

Particular attention must be paid to establishing the importance of various behaviors as risks for the elderly. As the preceding discussion has suggested, serious gaps exist in our knowledge about the mutability of such risks and, therefore, about the payoff in stopping or starting various behaviors at different ages and in the presence of specific conditions. Concerns about the elderly have focused on both the value and the feasibility of intervention, but more recent experience offers more optimism. The goals of such research should include identifying the factors that suggest whether or not an older person is likely to change his or her behavior.

The increased mortality of the bereaved and the unmarried provides clues worth following up in specifically designed studies. Observations about the increased risk of the unmarried, for example, are derived from large-scale examination of marital status at the time of death. We now need to examine the patterns of socialization as well as the marital history side by side with the morbidity experience of various groups of older people before we can posit any causal relationships. Even then we must be careful in separating the factors that increase risk from those that are beneficially mutable.

CLINICAL RESEARCH

Improving our understanding of tertiary prevention requires clinical research. More effective intervention techniques are needed, especially for the improvement of functioning and the minimizing of disability and handicap. Clinical trials should be encouraged in stroke rehabilitation, treatment of incontinence, posthospital management of fractures, environmental modification, and a host of other areas. We want to avoid the self-fulfilling prophecy that shows elderly persons at poor risk for rehabilitation because statistics show fewer good results when, in fact, fewer therapies are offered to the elderly in the first place. The literature on the efficacy of various cancer surgeries and chemotherapies for the elderly has been plagued with this problem. Similarly, it is hard to know the characteristics of elderly post-stroke patients who are good candidates for rehabilitation if only a select group is offered reha-

bilitation in the first place; the results merely reflect self-fulfilling prophecy.

Examining the effects of interventions on the elderly—and particularly those interventions designed to improve functional outcomes—requires that social factors as well as medical factors be built into the research design. Too often these classes of data are not integrated in the same study. It is also important that simple social variables such as marital status, household composition, and income be measured repeatedly. These items are as subject to change in the elderly as are the physiological parameters, but too often they are collected once at baseline and treated as fixed. This can mean, for example, that the contributions of widowhood, remarriage, or changes in availability of household support are inadequately considered in the analysis.

VALUES

Those advocating preventive interventions for the elderly must look both at the quality and the quantity of life. We have already noted that the shorter life expectancy of older persons often makes prevention more cost effective. Less work has been devoted to examining preferences for quality of survival [185]. If we are seriously to consider shifting resources from curative to preventive care, we should find more sensitive measures of the quality of the years saved. It is misleading to assume that one year is just like another or that the ability to function socially may not influence the value placed on that additional year.

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